

Geologic Resources Inventory Workshop Report  
Mesa Verde National Park, CO

**Joe Gregson**  
**NPS Inventory and Monitoring Program**

WORKSHOP AGENDA

TUESDAY: July 14, 1998 - Mesa Verde National Park (MEVE)

1:00 PM - Field Trip in the park with Mary Griffitts

WEDNESDAY: July 15, 1998 - Mesa Verde National Park

9:00 AM - Welcome and Opening Remarks

- Larry Wiese, MEVE Superintendent
- Joe Gregson, NPS I&M Program

Introductions, Round Table

NPS I&M Program Overview and Geological Resources Inventory

- Joe Gregson, I&M

NPS Geological Resources Division and Overview Colorado Pilot Projects

- Bruce Heise, GRD

Geological Resources Needs, Hazards, and Issues at MEVE

- Marilyn Colyer, MEVE Staff

Geological Resource Ideas for Interpretation at MEVE

- MEVE Staff

USGS Geological Activities and Research

- Jim Fassett, USGS

Other Cooperators and Discussion

12:00 PM Lunch

1:00 PM - Discuss Mary Griffitts new geological mapping.

- Geology map digitizing project and geology-GIS digital data model for MEVE.
- Deliverables from mapping, cooperators, and NPS inventory
- Authors for MEVE geologic resources report and/or other papers
- Demonstration of new culturally-related geology exhibit for MEVE museum.

## WORKSHOP COOPERATORS

Larry Wiese, MEVE Superintendent  
George San Miguel, MEVE NR  
Marilyn Colyer, MEVE NR  
Allan Loy, MEVE GIS  
Chris Wilkins, MEVE GIS  
Will Morris, MEVE Interpretation  
Gary Gasaway, MEVE Maintenance  
Mary Griffiths, MEVE VIP Geologist  
Mary Gillam, MEVE VIP Geologist/Consultant  
Bruce Heise, NPS GRD  
Tim Connors, NPS GRD  
Joe Gregson, NPS NRID I&M  
Jim Fassett, USGS Geologist  
Doug Ramsey, NRCS Soil Survey  
Chris Carroll, CGS Denver

## WORKSHOP SUMMARY

An inventory workshop was held at Mesa Verde National Park on July 14-15, 1998 to discuss the park's geologic resources and associated issues and needs. Mesa Verde N.P. also administers Yucca House National Monument and the easternmost unit of Hovenweep National Monument, Goodman Point. Fourteen cooperators participated in the one and a half day workshop.

Larry Wiese, MEVE Superintendent, attended the first part of the meeting and noted in his remarks that MEVE is a World Heritage Site. After introductions by the participants, Joe Gregson presented an overview of the NPS I&M Program, the status of the natural resource inventories, and the geological resources inventory. Bruce Heise followed with an overview of the organization of the Natural Resource Stewardship and Science Washington Office, GRD, and the Colorado pilot project. Afterward, Marilyn Colyer and Alan Loy facilitated and compiled a flip chart of geologic hazards and needs.

### Hazards

Hazards were discussed at length. In general, the types of hazards at Mesa Verde may be divided into geologic hazards and land use hazards. Land use hazards include slumping and rock falls associated with roads, location of septic systems, utilities, and building sites, as well as damage to archeological features. Geologic hazards in general include rockfall, debris flows, landslides, slumps, flood erosion and deposition, and swelling soils.

Although rock falls are probably the #1 hazard to the public in the park, especially along roads and trails (e.g., the Boulder Nest section of the entrance road), little can be done at present other than the ongoing road hazard monitoring and cleanup.

Major slumps and landslides have affected park roads several times through the years. The group knew of only one M.S. thesis that had studied the road landslides (Dan Plasea, date?).

Several slump-prone areas have been repaired and engineered to limit the local water infiltration rate and/or to drain and reduce pore-pressure in the affected sediment, but new areas of concern appear each year. Since the park has only one major road, a major slump or washout has the potential to trap a considerable number of visitors in the park. None of the group knew if an emergency plan existed to address a major road failure, so the park staff volunteered to check.

Recent episodes of water seeping into alcoves and causing archeological damage or back (roof) collapse were discussed. Some of the seepage was traced to the drainage of domestic water and septic system leaching and subsequently mitigated. The need for better understanding of local groundwater systems, recharge areas, and infiltration/conductivity rates was outlined. Although Resource Management Plan project statements have been written to study the local groundwater and spring locations, as yet, none have been funded. The locations of springs have archeological significance as sites of alcove development and relate directly to the paleo-demography of the ancient inhabitants. Win Wright, a local groundwater consultant, has done some work in the park and may be approached about a potential groundwater project or report.

Routing of a new pipeline for the park's domestic water was discussed. Mary Griffiths expressed reservations about the fact that the water line will be placed in a slant-drilled hole that crosses a major joint system that might be prone to faulting, especially if the water line ruptured. The drilling process and use of lost circulation materials for drilling in areas such as this were briefly discussed.

Flood hazards and erosion in burned areas of the park have increased since the major fires in the recent past. Increased runoff from the burned areas contribute to increased flooding (minor as yet), and a hydrologic study of these areas would help answer management questions related to potential flood magnitude. Especially important is the need to delineate floodplains for land use and construction plans.

Debris flows also present human hazards that are relatively low right now but will probably gain importance as outside development encroaches on the park's boundary. Mesa Verde is a highland with ephemeral canyons, subject to debris flows, draining outward onto adjacent lands. Mary Gillam stated that the terraces and benches in the Mancos valley were covered with debris flow sediments. Locations in and near the mouths of Mesa Verde's ephemeral canyons are in highly-hazardous debris flow areas, which should be considered in land use planning.

#### Research Needs

Geologic research is needed and should be encouraged--both in the Cretaceous Mesa Verde Group rocks and in the Quaternary and other deposits.

In the Cretaceous rocks, the depositional history of the Cliffhouse Sandstone, which has its best exposures in the park, records an extensive transgressive phase of the Mancos Sea. Furthermore, the sequence stratigraphy of the Mesa Verde type section has never been studied in detail, and the type section itself has never been defined. Mary Griffiths suggested that extensive work on the Cretaceous fossil record, especially plants, is needed to enhance correlation and dating of the rocks, especially the Menefee Sandstone. A comparative collection and terminology for Cretaceous fossils is also needed.

Numerous igneous dikes cut the Cretaceous sedimentary rocks of Mesa Verde, and a study their areal extent and petrography would greatly enhance the understanding of their origin and emplacement.

There was discussion of the discovery and radiometric dating of charcoal in sediments at Colorado National Monument (COLM) and its implication for potential fire recurrence studies. Although this had never been considered at MEVE, the recent fire and changes in runoff suggest the need to review and evaluate the potential for gleaned fire history from Quaternary deposits. The NPS fire program will visit COLM in October to evaluate these ideas. Bruce Heise will participate and report on the potential for further study.

The NRCS has recently completed field work for a soil survey of the park as part of the Montezuma County project. Doug Ramsey said that the digital map should be ready by early next year and will be forwarded to the park and the I&M Program.

Additional studies of the Quaternary deposits are needed. Paleosols contain information on previous climatic conditions in the area. As noted in the hazards section, locations of rockfall, debris flow, landslide, slump, colluvial, and alluvial deposits are important to know for land use considerations. A detailed surficial geology map is a high priority for the park and would provide insight for both modern land use as well as ancient land use related to the cultural resources.

#### Interpretation

Interpretive needs and current resources were discussed. Mary Griffiths has written a generalized book, Guide to the Geology of Mesa Verde National Park, that is sold in the museum and visitor center. Other saleable items are needed and might include a fire history, a detailed geologic map, a geologic road log, and the inventory report. A road log/guide for the Colorado Plateau region would provide a connection for visitors travelling from park to park. Documentation and illustration of geologic units exposed in several parks would make a good common theme that could include correlated cross sections between associated parks. Road log/guides from Mesa Verde to adjacent parks would also provide continuity between units. Most of the items for visitor sale should be written in lay terms. MEVE staff also pointed out that the fire had burned out some existing exhibits and signs that have not yet been replaced. Road signs for geologic unit names and unique features were suggested and discussed, but new signs might not be approved due to both traffic safety and flow issues. A suggestion that road sign text be kept short and simple with visitors using a more detailed guidebook explaining the features seemed to be a more workable and acceptable alternative.

#### Maps

Maps were discussed at length and considered by the group to be one of the more valuable products that the geologic inventory could provide.

A 1:50,000 scale geologic hazard map exists for La Plata County but there is no hazard map for Montezuma County or MEVE available. As discussed earlier, a geologic hazards map or set of GIS layers are needed for the park.

A surficial geologic map of Mesa Verde is also not available. Although a surficial map would require a new mapping project, it would be valuable for land use planning, cultural resource demographic studies, and geologic hazards assessment.

The existing geologic map for MEVE is on a planimetric base (USGS Bull. 1072-M, Plate 49, or USGS Geologic Map OM-152, Wanek, 1959) that is not tied to the topography (i.e., significant location errors probably exist). In addition, other smaller scale geologic maps cover MEVE but are not suitable for digitizing. Fortunately, Mary Griffiths has just completed mapping the geology and faunal zones of the park on a topographic base that can be combined and compiled into a suitable map for the digital geology. Jim Fassett offered to map the missing coal seams and add them to the project at minimal cost. Alan Loy will work with Mary and Jim to get the maps digitized once compiled. Alan will also work with Joe Gregson to coordinate the GIS attributes and resulting map products. Once the map is complete, the Park Team will consider publication of the map in coordination with the park's natural history association.

GIS layers and geologic attributes for the GIS data that were discussed include:

1. lithology (formations, members(?), and faunal zones in the Mancos Shale)
2. joints and faults
3. travertine
4. unique features (T&E species related to specific rocks and the erosional sun symbols in the Cliff House Sandstone)
5. springs and alcoves
6. intrusives
7. silcretes, ash beds, and gravels

Mary Griffiths will also provide geologic maps for Yucca House N.M. and the Goodman Point unit of Hovenweep N.M. for digitizing into the GIS (the remainder of HOVE is administered by the SE Utah Group and will be evaluated separately). Yucca House N.M. has gravels, Mancos, and Juana Lopez(?) exposed. Goodman Point is thought to be all in the Dakota Sandstone.

A soils map is needed, but the recently completed survey by NRCS should satisfy this need for both the park and the NPS I&M Program soils inventory.

## Report

Several of the cooperators were willing to work on and complete a geologic report for the park within about a year. At first, Bruce Heise was chosen as compiler and editor, but Jim Fassett will assume that role as a condition of his involvement by the USGS. The report will be peer reviewed and published as a USGS Professional Paper or Bulletin. Mary Griffiths will be the senior author with other contributions coming from Jim (regional and coal geology), Mary Gillam (Quaternary geology), Doug Ramsey (soils), Alan Loy (map preparation), and hopefully, a section on the groundwater/springs by Win Wright, Bob Jarrett, or Larry Martin.

## ACTION ITEMS

1. Mary Griffiths has recently completed mapping the park on 1:24,000 scale topographic base maps which she and park staff will compile into a geologic master on a stable mylar base.
2. Jim Fassett volunteered to map the missing coal seams and add them to the map. Jim thought that this project would take 2-4 weeks and could be done for the cost of his travel to the park (the park would provide housing and with I&M funds for transportation and per diem).
3. Once the mylar master is ready, Alan Loy, the GIS Specialist at the park, will digitize the maps with the assistance of Mary Griffiths (geology) and Joe Gregson (GIS model).
4. Jim Fassett, Mary Griffiths, and Mary Gillam agreed to co-author a geologic report for the park that will be used for sections of the I&M report. A USGS Bulletin or Professional Paper would require that Jim be the scientific editor and that the report be peer reviewed. Completion of the report should take about one year.
5. Joe Gregson will seek permission from the Mesa Verde National Park Natural History Association (MVNPNHA) to publish Mary Griffiths' existing report and map in the I&M Program's Internet database.
6. Publication plans for the final Mesa Verde National Park geologic map will be reviewed upon completion and in cooperation with the USGS and MVNPNHA as needed.
7. GRD and the MEVE Park Team will assist with preparation of mapping proposals and RMP project statements to complete surficial geology and geologic hazards for the park.

## ANTICIPATED BUDGET

1. Materials/supplies to compile MEVE geologic map master on mylar (FY98) \$ 500
2. 2-4 weeks travel for Jim Fassett to map coal seams for MEVE map (FY99?) \$500-1,500
3. Digitize 6 MEVE quads, YUHO, and Goodman Point unit of HOVE (FY99) \$10,000
4. Publication of USGS Professional Paper/Bulletin on MEVE geology (FY99?) \$ ???
5. Publication of MEVE geologic map (on demand prints or press run, FY99?) \$ ???

## APPENDIX A: OVERVIEW OF GEOLOGIC RESOURCES INVENTORY

The NPS Geologic Inventory is a collaborative effort of the NPS Geologic Resources Division (GRD) and Inventory and Monitoring Program (I&M) with assistance from the U.S. Geological Survey (USGS), American Association of State Geologists (AASG), and numerous individual volunteers and cooperators at NPS units, colleges, and universities.

From the perspective of the servicewide I&M Program, the primary focus (Level 1) of the geological inventory is 1) to assemble a bibliography of associated geological resources for NPS units with significant natural resources, 2) to compile and evaluate a list of existing geologic maps for each unit, 3) to develop digital geologic map products, and 4) to complete a geological report that synthesizes much of the existing geologic knowledge about each park. The emphasis of the inventory is not to routinely initiate new geologic mapping projects, but to aggregate existing information and identify where serious geologic data needs and issues exist in the National Park System.

The NPS Geologic Resources Division is an active participant in the I&M Program and has provided guidance and funding in the development of inventory goals and activities. GRD administers the Abandoned Mine Lands (AML) and Geologists In Parks (GIP) programs which contribute to the inventory. NPS paleontologists, geologists, and other natural resource professionals also contribute to inventory planning and data. A major goal of the collaborative effort is to provide a broad baseline of geologic data and scientific support to assist park managers with earth resource issues that may arise.

For each NPS unit, a cooperative group of geologists and NPS personnel (the Park Team) will be assembled to advise and assist with the inventory. Park Teams will meet at the each NPS unit to discuss and scope the geologic resources and inventory, which is the subject of this report. If needed, a second meeting will be held at a central office to evaluate available geologic maps for digital production. After the two meetings, digital geologic map products and a geologic report will be produced. The report will summarize the geologic inventory activities and basic geology topics for each park unit. Due to the variety of geologic settings throughout the NPS, each report will vary in subject matter covered, and section topics will be adapted as needed to describe the geologic resources of each unit. Whenever possible the scientific sections of the report will be written by knowledgeable cooperators and peer reviewed for accuracy and validity.